54TH CONGRESS, 1st Session. } HOUSE OF REPRESENTATIVES. { DOCUMENT No. 168.

SURVEY OF MERRIMAC RIVER, MASSACHUSETTS.

LETTER

FROM

THE SECRETARY OF WAR,

TRANSMITTING,

With a letter from the Chief of Engineers, report of survey of Merrimac River, Massachusetts.

JANUARY 23, 1896.—Referred to the Committee on Rivers and Harbors and ordered to be printed.

WAR DEPARTMENT,
Washington, D. C., January 22, 1896.

SIR: I have the honor to inclose herewith a letter from the Chief of Engineers, dated January 18, 1896, together with a copy of report from Lieut. Col. S. M. Mansfield, Corps of Engineers, dated January 15, 1896, of a resurvey made by him in compliance with the provisions of the river and harbor act of August 17, 1894, of Merrimac River, Massachusetts.

Very respectfully,

DANIEL S. LAMONT,
Secretary of War.

The SPEAKER OF THE HOUSE OF REPRESENTATIVES.

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., January 18, 1896.

SIR: By the terms of the river and harbor act of August 17, 1894, the Secretary of War is directed, out of the appropriation on hand, to make a resurvey of Merrimac River, with a view of obtaining a depth up to Haverhill equal to that over the bar at Newburyport, and I have now the honor to submit the accompanying report of January 15, 1896, with map, by Lieut. Col. S. M. Mansfield, Corps of Engineers, of the results of the survey thus provided for.

Colonel Mansfield presents a project for securing a channel to Haverhill 12 feet deep at mean low water, 150 feet wide above Newburyport and 200 feet wide below, and estimates that the necessary dredging and rock excavation will cost $1,496,851.07.

In explanation of the estimate Colonel Mansfield states that—

The cost of making the improvement will be great owing to the lack of a suitable dumping ground for receiving the dredged material, which will either have to be

towed to sea, an expensive operation, almost impracticable, or better, rehandled upon shore.

Very respectfully, your obedient servant,

W. P. CRAIGHILL,
Brig. Gen., Chief of Engineers.

Hon. DANIEL S. LAMONT,
Secretary of War.

SURVEY OF MERRIMAC RIVER, MASSACHUSETTS.

UNITED STATES ENGINEER OFFICE,
Boston, Mass., January 15, 1896.

GENERAL: I have the honor to transmit herewith a map of Merrimac River, Massachusetts, and a report thereon made in accordance with the requirements of the river and harbor act of August 17, 1894:

Merrimac River, Massachusetts: The Secretary of War is directed, out of the appropriation on hand, to make a resurvey of said river with a view of obtaining a depth up to Haverhill equal to that over the bar at Newburyport.

This survey was made by United States Asst. Engineer T. T. Hunter Harwood, assisted by Charles W. Mason, United States hydrographer, and attention is respectfully invited to Mr. Harwood's accompanying report for the details thereof.

The plot of the survey is most complete in itself as to the character of the river, leaving little to be said in explanation. I have indicated thereon a channel of a width of 150 feet above Newburyport and 200 feet wide below, which will require the minimum of work to secure a channel up to Haverhill of 12 feet depth at mean low water, the equal of that now on the bar at Newburyport, and have shaded the portion where dredging and blasting will be required to secure the results looked for.

The total length of channel from the bar to Haverhill is 20½ miles, of which 9½ miles will require improvement.

From the soundings and borings made, the general character of the bottom appears to be mud, sand, gravel, and clay, interspersed with bowlders; and at Newburyport, in the vicinity of the north and south piers, at Rocks Bridge, and at Haverhill, ledge will be encountered in the work of improvement.

The cost of making the improvement will be great, owing to the lack of a suitable dumping ground for receiving the dredged material, which will either have to be towed to sea, an expensive operation, almost impracticable, or better, rehandled upon shore, and the following estimate is submitted:

For dredging and rehandling 1,305,998 cubic yards of material, scow measurement, at 65 cents per cubic yard	$848,898.70	
For ledge-rock excavating and rehandling, 34,125 cubic yards, at $15 per cubic yard	511,875.00	
		1,360,773.70
Contingencies, supervision, etc	136,077.37	
Total		1,496,851.07

Very respectfully, your obedient servant,

S. M. MANSFIELD,
Lieut. Col., Corps of Engineers.

Brig. Gen. W. P. CRAIGHILL,
Chief of Engineers, U. S. A.

REPORT OF MR. T. T. HUNTER HARWOOD, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Boston, Mass., January 13, 1896.

COLONEL: I have the honor to submit the following report on the survey of Merrimac River, Massachusetts, made from December, 1894, to October, 1895, in accordance with your instructions, and therewith a map of the survey drawn to a scale of 1:10,000.

TRIANGULATION.

The stretch of river covered by the survey, from the ocean to Haverhill, is about 20 miles in length, and is bordered by seven cities or towns, the river forming the boundary line between them on the north or south.

The Massachusetts State Topographical Survey has recently accurately determined the boundary lines between these several townships and fixed permanent bound stones, the geographical position of each stone being carefully determined, and a number of these stones are located upon the banks of the river.

Such of these stones as were conveniently located were selected as primary stations for the purpose of triangulation for the survey, and were plotted on the map by means of their latitude and longitude as furnished by the office of the State topographical survey.

Between these points a secondary system containing 166 points was established, following the banks of the river and forming a complete and satisfactory system of triangulation for use in the survey.

HYDROGRAPHY.

For the purpose of securing connected observations of tides throughout the length of river to be surveyed, levels were run three times from the bench mark at Black Rock Beacon at the mouth of the river to Ringbolt Rock above Haverhill. By means of these levels tide gauges were set, with 0.0 in a common horizontal plane, at the following stations: Central Wharf, Newburyport, mouth of Powow River, Rocks Bridge, Curriers Shoal, Groveland Bridge, and Haverhill Bridge.

Observations of every high water and low water at each of these stations were taken, covering a complete lunation, from May 27 to June 26, 1895, and the mean high water and mean low water at each gauge determined.

The information secured by these observations is recorded in a table entitled "Summary of tide observations" placed upon the accompanying map.

Bench marks were established for each gauge in reference to the local mean low water, as follows:

Newburyport.—Top of abutment for stone steps at main entrance to custom-house is in reference 22.59 feet above local mean low water.

Mouth of Powow River.—Drill hole in stone under northeast end of iron railing on upriver side of Powow River drawbridge is in reference 15.29 feet above local mean low water.

Rocks Bridge.—Top of town bound stone "Haverhill No. 9," on north side of river, about 640 feet below bridge abutment, is in reference 19.48 feet above local mean low water.

Curriers Shoal.—Drill hole in top of Currier Rock in river (available after one-third ebb tide) is in reference 3.82 feet above local mean low water.

Groveland Bridge.—Drill hole in stone in Groveland abutment under end of iron railing on upriver side is in reference 23.63 feet above local mean low water.

Haverhill Bridge.—Drill hole in a projecting stone, about 4 feet above ground, in west end of pier between river and railroad track in Bradford, is in reference 20.11 feet above local mean low water.

Ringbolt Rock.—Drill hole in top of rock is 11.77 feet above mean low water at Newburyport.

At the bar (Established in 1880): A drill hole (leaded) in the third course of masonry, facing the river, in Black Rock Beacon, is in reference 9.22 feet above local mean low water.

Soundings were taken on ranges varying from 20 feet to 400 feet apart throughout the river, and were located by intersecting angles from suitable shore stations.

A total number of 32,882 soundings were taken in the survey, 5,302 of which were fixed by angles, and 902 were borings below the bottom to determine the character of underlying material.

The soundings are reduced to mean low water of the locality where taken, but in making this reduction it was assumed that the mean low water lay in a regular slope between two established gauges. Excepting, therefore, in the immediate

vicinity of an established gauge, the mean low-water plane is approximate, but the possible error in any case is small.

The triangulation and leveling were executed during the winter months, and the tide observations and soundings were taken after the annual spring freshet in the river had subsided.

DESCRIPTION OF CHANNEL AS DEVELOPED BY THE SURVEY.

The mouth of the Merrimac River is obstructed by a sea bar, over which about 12 feet at mean low water can be carried in a channel about 300 feet wide. This channel is now being improved under appropriations for improvement of Newburyport Harbor, Massachusetts.

After crossing the bar, this 12-foot channel continues up the river for a distance of 2 miles, maintaining a least width of 300 feet until within one-half mile of the wharves at Newburyport. Here it is obstructed by ledges and shoal ground, marked by two cribs known as the "north" and "south piers." At this point the channel has been improved, under appropriations for the improvement of Merrimac River, by the removal of these ledges to a depth of 9 feet below mean low water. This shoal ground extends up the river for about 1,500 feet, not less than 9 feet deep and of varying width, where the 12-foot channel again commences and continues with a least width of 200 feet for about 5 miles to a point about three-fourths of a mile above the mouth of Powow River.

Two mid-channel ledges were found in this channel, lying between Carrs Island and the south shore, with a least depth over them of 8.1 and 4.3 feet; but there is at least 200 feet width of channel available in passing them, and if well buoyed or marked by spindles, they might not be regarded as serious obstructions.

From three-fourths of a mile above Powow River no continuous 12-foot channel exists, and the available channel gradually shoals to about 6.5 feet at Rocks Bridge, about 10 miles above Newburyport.

At Rocks Bridge, Curriers Shoal, both ends of Silbys Island, and between the bridges at Haverhill the channel has been improved under previous appropriations, and through these points up to Haverhill a channel exists in which about 6 feet can be carried at mean low water, but in places this channel is very narrow and difficult of navigation.

The total length of channel from the bar to Haverhill is $20\frac{1}{2}$ miles, of which $9\frac{1}{2}$ miles will require improvement to make available to Haverhill the same depth of water at mean low water (12 feet) as is obtained over the bar at the mouth of the river.

From the soundings and borings made the general character of the bottom appears to be mud, sand, gravel, and clay, interspersed with large and small bowlders; and at Newburyport, in the vicinity of the north and south piers, at Rocks Bridge, and at Haverhill, ledge will be encountered in the event of improvement.

The river is crossed by 7 bridges, containing conveniently located draws, with widths of opening as follows:

1. Newburyport Highway Bridge, 70 feet.
2. Boston and Maine Railroad Bridge at Newburyport, 63 feet.
3. Deer Island Bridge, 60 feet.
4. Rocks Bridge, 57 feet.
5. Groveland Bridge, 65 feet.
6. Haverhill Bridge, 38 feet.
7. Boston and Maine Railroad Bridge at Haverhill, no draw.

The operations of the party in the field were in charge of Mr. Charles W. Mason, hydrographer.

Very respectfully, your obedient servant,

T. T. HUNTER HARWOOD,
Assistant Engineer.

Lieut. Col. S. M. MANSFIELD,
Corps of Engineers, U. S. A.

MERRIMAC RIVER, MASSACHUSETTS.

SURVEY MADE IN ACCORDANCE WITH ACT OF CONGRESS OF AUGUST 17, 1894

UNDER THE DIRECTION OF

LIEUT. COL. S. M. MANSFIELD, CORPS OF ENGINEERS, U.S.A.

BY T.T. HUNTER HARWOOD, ASST. ENGR.

AIDED BY

CHAS. W. MASON, HYDROGRAPHER.

DECEMBER, 1894 – OCTOBER, 1895.

SCALE OF MAP.

1000' 500' 0 1000 2000 3000 4000 5000 6000 7000 8000 FT.

U.S. ENGINEER OFFICE, BOSTON, MASS.,
JANUARY 15, 1896.
RESPECTFULLY FORWARDED TO THE CHIEF OF ENGINEERS
WITH REPORT OF THIS DATE.
M. Mansfield
LIEUT. COL. OF ENGINEERS.

NOTE.

TIDE OBSERVATIONS covering a complete lunation were taken at Newburyport, Mouth of Powow River, Rocks Bridge, Curriers Shoal, Groveland Bridge and Haverhill Bridge, and permanent BENCHMARKS were established as follows:

NEWBURYPORT: Top of abutment for stone steps at main entrance to Custom House is in reference 22.'59 above local Mean Low Water.

MOUTH OF POWOW RIVER: Drill hole in stone under N.E. end of iron railing on up river side of Powow River Draw Bridge is in reference 15.'29 above local Mean Low Water.

ROCKS BRIDGE: Top of town bound stone "Haverhill No. 9", on North side of river about 640 feet below bridge abutment, is in reference 19.'48 above local Mean Low Water.

CURRIERS SHOAL: Drill hole in top of Currier Rock in river (available at 1/3 ebb tide) is in reference 3.'82 above local Mean Low Water.

GROVELAND BRIDGE: Drill hole in stone in Groveland abutment, under end of iron railing on up river side, is in reference 23.'63 above local Mean Low Water.

HAVERHILL BRIDGE: Drill hole in a projecting stone, about 4 feet above ground, in West end of pier between river and railroad in Bradford, is in reference 20.'11 above local M.L.W.

RINGBOLT ROCK: Drill hole in top of rock is 11.'77 above M.L.W. at Newburyport.

AT THE BAR. (Established in 1880) A drill hole (leaded) in the third course of masonry of Black Rock Beacon, facing the river, is in reference 9.'22 above local Mean Low Water.

(See table "Summary of Tide Observations" for connection between these benches.)

SOUNDINGS are expressed in feet and tenths and are referred to Mean Low Water of the locality where taken.

CONTOURS are shown thus:

Mean High Water
" Low "
6 feet contour
12 " "
18 " "

SUMMARY OF TIDE OBSERVATIONS.

MAY 27 – JUNE 26, 1895.

GAUGE STATION.	MEAN RISE OR FALL OF TIDE	HIGHEST OBSERVED TIDE ABOVE M.H.W.	LOWEST OBSERVED TIDE BELOW M.L.W.	M.L.W. COMPARED WITH M.L.W. AT BAR	M.H.W. COMPARED WITH M.H.W. AT BAR	MEAN DURATION OF RISE	MEAN DURATION OF FALL	MEAN DIFFERENCE OF TIME OF H.W. AND L.W. COMPARED WITH GAUGE AT NEWBURYP'T. H.W. LATER	L.W. LATER
	FEET	FEET	FEET	FEET	FEET	HR. MIN.	HR. MIN.	HR. MIN.	HR. MIN.
AT BAR *	7.68	1.75	1.67						
NEWBURYPORT	7.58	1.69	0.77	+0.13	−0.03	5−52	6−34	0−00	0−00
MOUTH OF POWOW RIVER	7.04	1.53	0.65	+0.51	−0.13	5−40	6−47	0−24	0−37
ROCKS BRIDGE.	5.67	1.61	0.62	+2.75	+0.74	5−23	7−02	1−09	1−35
CURRIERS SHOAL	5.27	1.28	0.55	+4.08	+1.67	4−46	7−24	1−18	2−04
GROVELAND BRIDGE	4.96	1.44	0.80	+3.50	+0.78	4−44	7−41	1−27	2−32
HAVERHILL BRIDGE	4.62	1.56	1.17	+4.45	+1.39	4−21	7−57	1−36	3−07

* FROM OBSERVATIONS TAKEN OCT. 24 – NOV. 23, 1880. BENCHMARK CONNECTED WITH BENCHMARK AT NEWBURYPORT BY SURVEYORS LEVEL IN 1895.